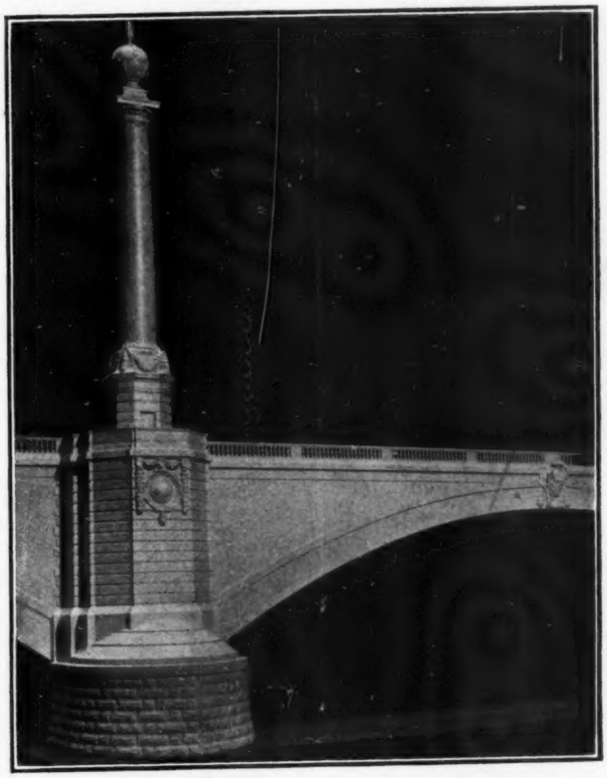
PUBLIC WORKS

CITY COUNTY STATE



MAIN PIER AND CONCRETE SHAFT
SPRINGFIELD-WEST SPRINGFIELD BRIDGE

IN THIS ISSUE:

MAY 20, 1922

VOL. 52 NO. 20

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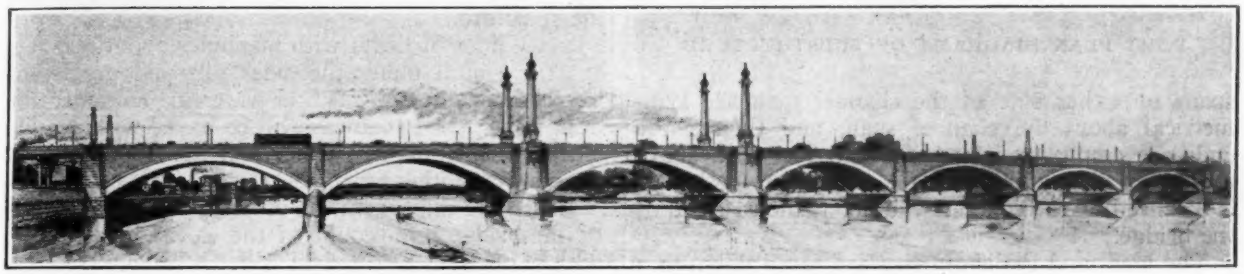
PUBLIC WORKS.

CITY **COUNTY** **STATE**

A Combination of "MUNICIPAL JOURNAL" and "CONTRACTING"

Vol. 52 **May 20, 1922** **No. 20**



SPRINGFIELD-WEST SPRINGFIELD BRIDGE WITH 110 TO 176-FOOT SPANS

Springfield-West Springfield Bridge

54,000 cubic yards of concrete, 3,560 tons of steel and nearly 11,000 foundation piles required for bridge.
General plan and principal details of 1,494 foot structure 80 feet wide and 56 feet high across the Connecticut River. Seven 5-rib reinforced concrete two-hinge river arches of 110 to 176 feet spans. Slab viaduct approach spans with concrete columns and steel columns enclosed in concrete. Concrete river piers on wood, shore piers on concrete pile foundations.

The new highway bridge across the Connecticut river at Springfield is a monumental $4,000,000 structure with graded approaches, 314 feet of viaduct and a seven-span river section 1,180 feet long, 80 feet wide and with roadway 56 feet in extreme height above low water. It will carry two 10-foot sidewalks and a 60-foot roadway with two electric car tracks, thus providing for one line of street cars and two lines of traffic moving in each direction simultaneously, and having a much greater capacity than the combined capacity of the two previously existing bridges that cross the river at Springfield.

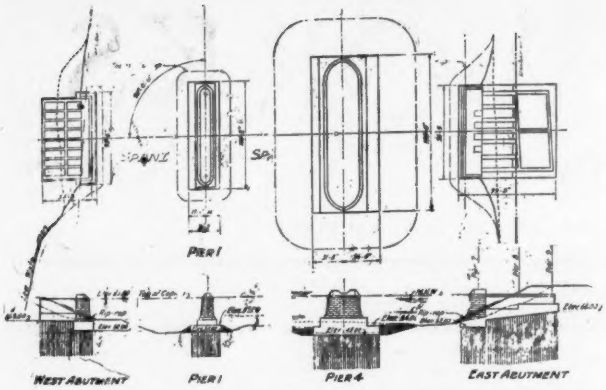
The clearance above low water is more than 40 feet for a length of 60 feet in the channel span, an amount which is greater than that of the existing bridges at Springfield and is approximately the same as the highest span at Hartford. The clear span and height above the water were fixed in accordance with the requirements of the War Department and will probably suffice for all navigation necessities, although it is so designed that the channel span can be replaced by a draw span if such action is necessitated by future demands.

The bridge is being constructed under an act of the Massachusetts State Legislature of 1915 by the Hampden County Commissioners. A contract covering the greater part of the work was awarded April 3, 1920, for $3,254,883, the highest bid received being $4,167,000. The bridge and the greater part of the approaches is expected to be completed July 31, 1922 at an estimated cost, exclusive of land takings and damages, of approximately $4,000,000.

GENERAL FEATURES.

Exploration borings in the river bed, subsequently confirmed by dredging and pile driving operations, indicated sand or gravel to a depth of 15 to 25 feet, then clay to a depth of 100 feet or more, with a hard stratum 50 feet below low water level. The substructure of the river bridge was therefore designed with concrete footings on wooden pile foundations so proportional and arranged that after completion of the bridge the waterway will be approximately the same as before operations were commenced, and as large as that at any of the other existing Springfield bridges.

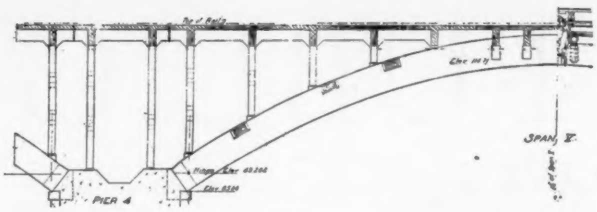
In the architectural treatment an attempt has been made to obtain a pleasing outline with little ornamentation. The channel span is flanked by four towers rising to a height of 84 feet above the sidewalk and having lanterns at the top. The two



PART PLAN DIAGRAMS OF SUBSTRUCTURE

spans on either side of the channel span are symmetrical about the channel span, and their shore ends are emphasized by towers 26 feet high above the top of the railing. The west end of the bridge is balanced by the concrete viaduct at the east end of the bridge.

The piers and the abutments are faced down to a point below water level with granite about three feet thick. Artificial stone ornamentation is provided at the ends of all piers and at the center of the channel span. The railing on the river spans is of open balustrade type and that on the approach viaduct is solid. The entire cost of the ornamental

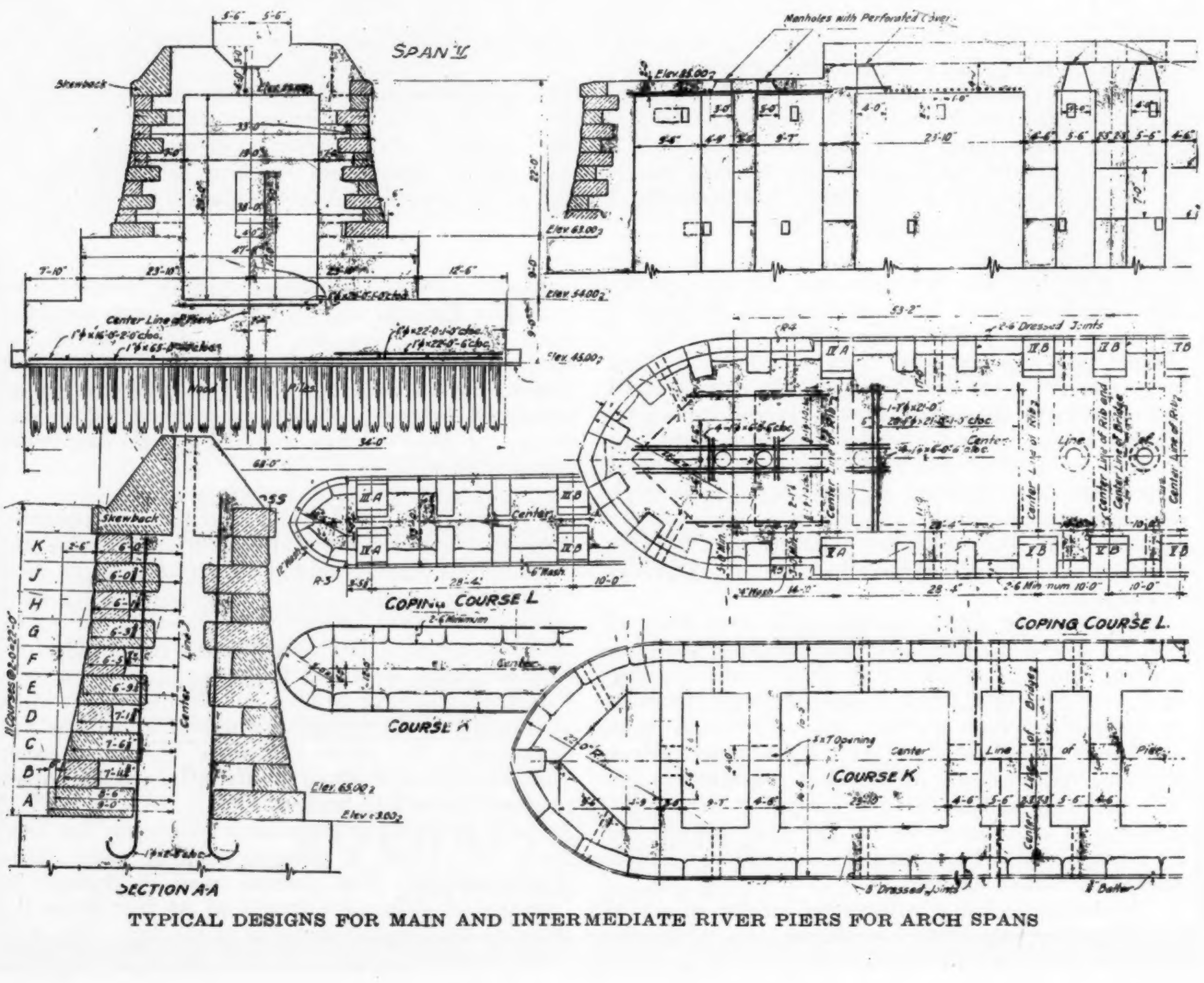


HALF ELEVATION OF CHANNEL SPAN AND PIER

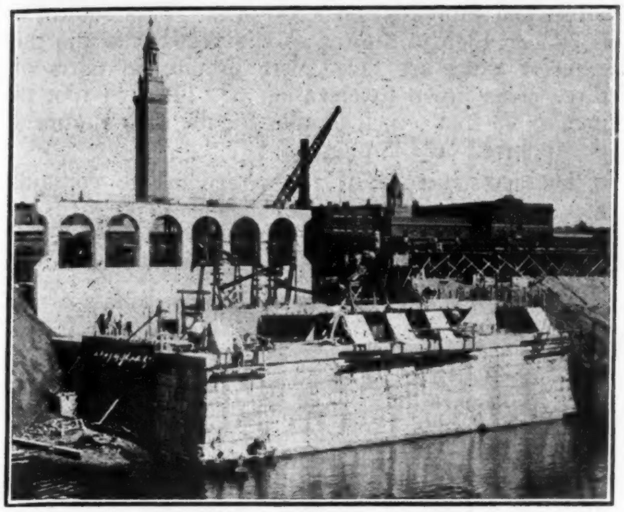
features, including the eight large and small towers, the cartouches on the channel span and the pier ends, is less than two per cent. of the total cost of the structure.

Sixty lines of ducts with manholes about 300 feet apart are built under the sidewalks and provisions have been made for gas and water mains under the deck slabs. The roadway will be paved with granite blocks with bituminous filler and the sidewalks will have a granolithic finish.

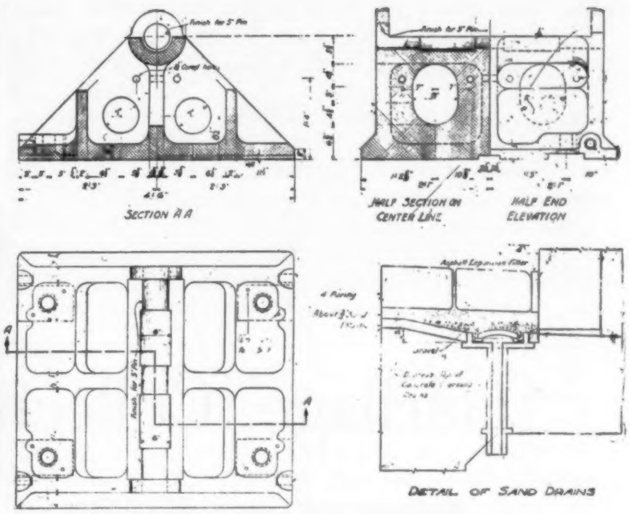
Extensive improvements are involved at both ends of the bridge on account of the elevation of grade, which on the Springfield side is about 15 feet maximum, involving a slope of about 3½ per cent. in all directions, of the street surfaces from the end of the bridge. In West Springfield the considerable amounts of land and grading necessary for the approaches have been donated to the county, and the roadway in the improved territory will first be



TYPICAL DESIGNS FOR MAIN AND INTERMEDIATE RIVER PIERS FOR ARCH SPANS



PIERS FOR APPROACH VIADUCT AND ABUTMENT



CAST STEEL PEDESTAL AND FLOOR DRAINS

constructed with a width of 60 feet, which may be eventually increased.

Except for a short grade of little less than four per cent., the maximum grade is 3½ per cent., which obtains over only a comparatively small part of the structure, the profile being a flat curve and level over the channel span.

RIVER PIERS AND ABUTMENTS.

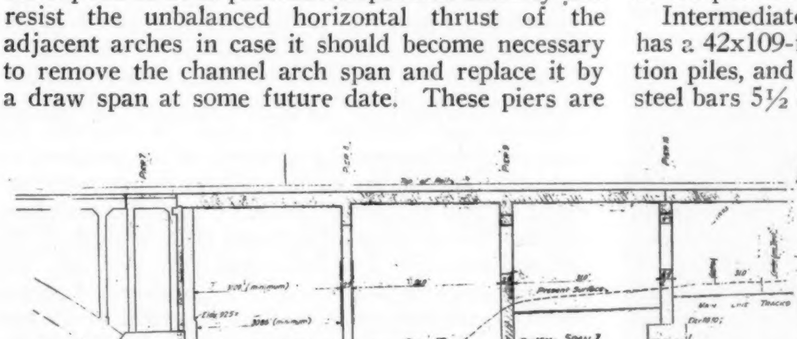
The seven arch spans are supported on two abutments and six intermediate piers, all having wood foundation piles with their tops embedded in concrete footings carried down to different levels from elevation 42 for pier 6 to 50 for pier 1, and to elevation 52 for both abutments.

The 10,500 pine foundation piles are from 20 to 40 feet in length, are spaced about two feet apart on centers and carry maximum construction loads of nearly 16 tons. The bottom of the concrete in the piers was required to be at least 18 inches below to tops of the piles.

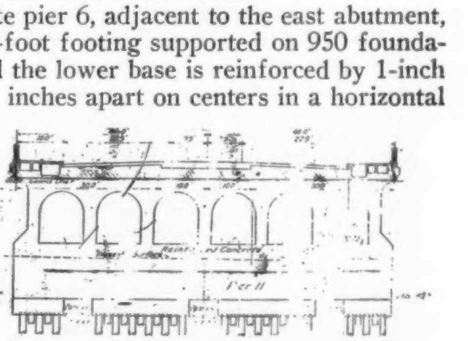
Piers 4 and 5 under the channel span are of special construction with a greater width than the other piers so as to provide independent stability and resist the unbalanced horizontal thrust of the adjacent arches in case it should become necessary to remove the channel arch span and replace it by a draw span at some future date. These piers are duplicates, with a 68x159-foot concrete footing, 9 feet in depth, supported on 2,263 piles and protected by rip-rap. The second course of the footing is narrower than the lower course, having a width of 47 feet 8 inches while the length remains the same, 68 feet. The upper surface of this course is nearly 2 feet below extreme low water and supports the main shaft of the pier 22 feet high, which is pointed at both ends and batters slightly to a width of 34 feet and a length of 155 feet at the coping. It is faced with eleven 2-foot courses of granite, headers and stretchers, all cut to plan. Above the coping there are granite skew-backs 5 feet 3 inches high, to receive the ends of the arch ribs.

To reduce the volume of concrete and diminish the foundation load, the pier is made hollow with eight chambers 19 feet long parallel to the bridge axis and 29 feet high, the widths varying from 5 feet 6 inches to 23 feet 10 inches. The chambers are separated by concrete walls 4½ feet thick, covered by reinforced concrete deck slabs 2 feet thick, and accessible through covered manholes in the deck. The outer walls of the chambers or the sides of the piers are at least 7 feet thick.

Intermediate pier 6, adjacent to the east abutment, has a 42x109-foot footing supported on 950 foundation piles, and the lower base is reinforced by 1-inch steel bars 5½ inches apart on centers in a horizontal



SECTIONAL ELEVATION OF ABUTMENT AND ADJACENT APPROACH VIADUCT



VIADUCT PIER AND CROSS SECTION

plane just above the tops of the foundation piles. The lower course of the footing is 11 feet deep and the second course is 10 feet deep. The pier shaft above is faced with granite and is reinforced with vertical rods to resist possible bending stresses during construction. The other intermediate piers are similar to pier 6, but have varying widths and numbers of piles in their foundations.

The abutments are very large, rectangular, cellular structures with massive continuous footing slabs, that for the east abutment being 95 feet 9 inches x 99 feet 3 inches in plan with a minimum thickness of 6 feet and supported on 1,806 piles. This abutment is 38 feet high to the top of the skewbacks and the exterior walls are faced with granite on parts of three sides down to elevation 63. The 54-foot 6-inch by 93-foot 6-inch footing for the west abutment is supported on 725 piles.

The substructure of the entire bridge contains about 34,000 yards of concrete and 4,700 yards of granite quarried at Cape Ann, near Gloucester, the granite being cut to dimensions and numbered before shipment.

(To be continued)

Garbage Collection in Goldsboro

Methods and Cost of Municipal Collection in a City of Twelve Thousand Population. New System of Accounting Gives Classified Costs by Months

Goldsboro, N. C., has a population of about 12,000. The city limits are irregular in shape and the city has maximum dimensions of about 2½ miles north and south and 1¾ miles east and west. It is fairly level. The Atlantic Coast Line Railroad passes north and south a little to the west of the center, while the Norfolk Southern Railroad crosses it from west to east. More than half the street mileage of the city is paved with asphalt, bitulithic and brick.

The city is governed by a mayor and board of aldermen, while a city manager, W. M. Rich, is employed by the board. The following facts with reference to the collection and disposal of garbage in the city have been furnished to us through the kindness of Mr. Rich.

Garbage, ashes and rubbish are collected by municipal forces, the cost being taken care of by direct taxation. The equipment for collecting garbage and rubbish consisted of five one-horse carts and a Ford truck until December 1, 1921, on which date the use of the truck was discontinued and an additional one-horse cart was substituted for it, it being considered that the truck was less efficient because of the continual stopping and starting. The city owns the horses used in collecting and pays the drivers $2.50 per day of ten hours.

Garbage and rubbish are disposed of at the city dump, which is on low land near the southern boundary of the town and alongside the railroad right of way. One of the main streets of the town leads past the grounds and is paved with asphalt to within about a half mile of the grounds. At this point the garbage and rubbish is dumped, the dumping and handling at this point being carried on systematically by a man who looks after both the dump and an incinerator that is located there, with occasional assistance of an extra man, although the cost of the extra man last year was kept down to $12 for the year. The refuse is dumped on the low land at the disposal grounds in layers about five feet deep, and a fire is kept continuously burning which disposes of practically all the combustible matter. The incinerator referred to is used only for disposing of dead animals.

Last year the city adopted a health and sanitation ordinance, one of the requirements of which is that "all business houses and private residences within the city are required to obtain a standard metal garbage can supplied with a cover which shall be placed at such location and at such times as shall be provided for by regulations which the city shall provide from time to time. Such regulations shall be published in a local newspaper and the public thoroughly acquainted therewith."

Garbage is collected twice a week, that on the north and south streets being collected on Tuesdays and Fridays and that on the east and west streets on Mondays and Thursdays. Wednesdays and Saturdays are used for the collection of ashes and rubbish, although some garbage also is collected on these days in case the housewife has forgotten to put it out on the regular days of garbage collection. Garbage and rubbish receptacles must be placed at the curb for collection, except in the case of hotels and restaurants in the downtown district.

During the past two or three months an effort has been made to determine as accurately as possible the amount of material which is being collected. Unfortunately there is no equipment at the dump for weighing each cartload. In order to estimate the amount of collection, the sanitary officer weighed on scales the collections made on days which were selected by him as average days. From this weighing and estimating it was concluded that, with an average collection of five loads per cart per day, the average weight was 1,000 pounds per cart. As there are six carts collecting, this gives a total of 15 tons per day. The garbage being collected four days a week would give 60 tons a week.

This amounts to approximately 520 pounds per capita yearly. This is two or three times greater than the average of the quantities usually reported by cities, and would apparently indicate that the people of Goldsboro are wasteful, or possibly that they place in the garbage pails considerable material not classified as garbage in other cities.

In checking up the collection of ashes and rubbish, it was found that the weight of this material averages per day of collection the same as garbage, or half as much for the year.

All of this work, together with the street cleaning, is supervised by an official called the sanitary officer who receives a salary of $1,680 a year. This salary is charged as follows: to street cleaning, $405; removing garbage, $810; removing rubbish and trash, $405; removing dead animals, $60. The man who looks after the incinerator dump is paid $75 a month and, as stated before, is aided occasionally by an extra man, which aid totaled only $12 last year.

During the latter part of the last fiscal year, which ended June 1, 1921, the officials devoted a large part of their energies to trying to perfect the organization in order to reduce complaints, which were very prevalent about a year and a half ago. This has been so successful that at present not more than six complaints a month are received. As soon as a complaint is received it is investigated in person by the sanitary officer, which investigation usually shows that the person making the complaint has told an untruth.

On June 1, 1921, a new budget system was adopted which provides a means of keeping very closely in touch with the cost of administration of the various city functions. Prior to this it was impossible to determine the cost of the various operations, but these can now be determined quite closely. The accompanying tables give the cost for the first eight months of the present fiscal year, No. 1 showing the costs of the department by months, and No. 2 the classified costs of the different departments for the eight months' period.

Schedule No. 1—Costs of Services, by Months

1921	Incinerator and garbage grounds	Removing garbage	Removing rubbish and trash	Removing dead animals	Totals
June	82.75	502.12	292.72	5.00	882.59
July	123.25	483.69	211.30	5.00	823.24
August	85.55	459.63	241.05	5.00	791.23
September	75.00	450.57	267.11	5.00	797.68
October	161.62	639.90	242.83	5.00	1049.35
November	85.35	501.51	224.85	5.00	816.71
December	79.00	496.64	197.71	5.00	778.35
1922.					
January	90.50	456.10	186.88	5.00	738.48
Totals	783.02	3990.16	1864.45	40.00	6677.63

Schedule No. 2—Clasisfied Costs for the Eight-Month Period

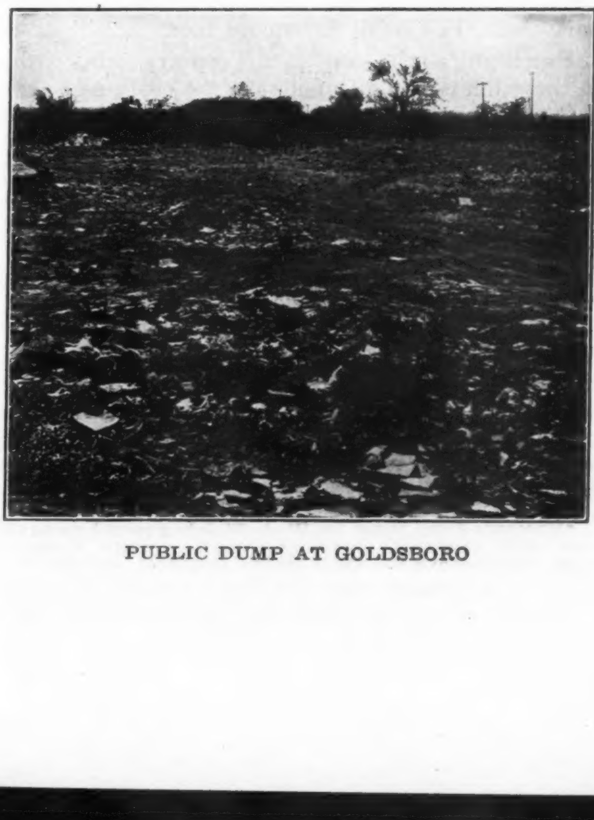
Items	Incinerator and garbage grounds	Removing garbage	Removing rubbish and trash	Removing dead animals	Totals
Salaries expense		540.00	270.00	40.00	850.00
Wages expense	612.00	2184.17	1119.74		3915.91
Fuel	64.75	116.51	31.14		212.40
Supplies for operating equipment	3.15	25.55	3.61		32.31
Supplies for subsistence of teams		796.72	291.26		1087.98
Tools and equipment replacements	2.10	22.25			
Material for building repairs	1.55	0.75			2.30
Material for equipment repairs	10.50	102.57			113.07
Contracted repairs	88.97	201.64	148.70		439.31
Totals	783.02	3990.16	1864.45	40.00	6677.63

RUBBISH CART USED IN GOLDSBORO

The cost of collecting the garbage during the eight months is shown to have been $3,990, giving a unit cost of $1.90 a ton. This cost per ton for collecting is below the average cost of a number of cities, which would indicate that the work is being done quite efficiently. The cost of collecting the rubbish was $1,864 which, using the estimated total amount above given would make the unit cost $1.78 per ton. A regular charge of $5 per month is made to cover the removal of dead animals. Horses, mules, etc., that are brought to the incinerator are disposed of there, but the city does not itself remove the larger animals and the charge made against the sanitary officer's salary in this connection is for that portion of his time which is used in investigation reports of dead animals.

Buffalo Filtration Plant

The Bureau of Water, of Buffalo, N. Y., is engaged in preparing plans for a filtration plant which will comprise forty filters, each with a normal capacity of 4,000,000 gallons per day. The construction will involve about 400,000 cubic yards of earth excavation, 5,000 cubic yards of rock excavation, and 50,000 cubic yards of reinforced concrete masonry in the sub-structures. These will consist of a low-lift pumping station, approximately 60 feet by 200 feet in area; a headhouse or coagulant building approximately 60 feet by 115 feet, and a filter building approximately 250 feet by 330 feet. It is expected that plans for these structures will be ready



PUBLIC DUMP AT GOLDSBORO

for receiving bids within the next month. The pumping plant and other mechanical features will presumably not be ready for bids until some time later.

The Use of Local Mineral Aggregate in Bituminous Macadam Roads *

The proper use of local mineral aggregate in bituminous road construction means great economy in these days of high transportation and labor costs.

It is possible to build good bituminous macadam road surfaces with practically any stone or coarse gravel found in the United States, provided this aggregate is free from loan, dust and silt when used.

The bituminous mixture is at best a wearing surface like the rails of a railroad and it must be thoroughly and properly supported by the subgrade or it will fail. The subgrade is the real road—it must be properly placed, thoroughly drained, well settled and compacted, and, on such a subgrade, a bituminous surface can be laid successfully with a mineral aggregate of comparatively low crushing strength, except on main trunk lines. It is, of course, very necessary to thoroughly bond this aggregate and keep it free from moisture, dirt and dust, for these are, in my opinion, the greatest enemies of proper bonding. * * *

Main trunk lines should have wearing surfaces which will carry any traffic and any speed, without failure, in spite of minor defects in the subgrade, but such surfaces are not necessary on minor roads and it is not economy to build them.

The safe crushing strength of trap rock or basalt averages approximately 350 tons per square foot; of the granites, 350 tons per square foot; of the limestones and marbles, 300 tons per square foot; of good air-cooled slag, 300 tons per square foot; of the sandstones, 215 tons per square foot; and ordinary chalk, 15 tons to the square foot.

Practically all the stone in this country comes within these limits and all of it save the chalk and very soft sandstones will make good bituminous macadam road surfaces. Specifications must vary with the types. The softer aggregates must be used in larger sizes, greater care exercised with them to keep out the dust and the rolling must be governed by the type of aggregate. The harder stone can be thoroughly compacted by heavy rollers and still penetrated and thoroughly bonded by the asphalt or tar, but the softer stones, when used in penetration work, must not be rolled as hard or they will not allow the binder to properly fill the voids, and care must be taken to keep the aggregate even, as many quarries have seams or stratums of soft shaley stone, which, if put in with the better material, will cause trouble.

*Excerpts from paper by W. A. Welch, general manager and chief engineer, Palisades Interstate Park Commission, read before the Good Roads Congress, January 17.

More care must be taken with the top course or seal coat, when the softer aggregates are used, to insure a thorough coating on the actual wearing surface. * * * Of all the failures of bituminous macadam surfaces which have come to my notice, none have been due in any way to the character of the mineral aggregate.

I know of one piece of penetration surface in which three experimental sections were laid, each of about 500 feet. In these sections were used trap rock or very hard basalt, limestone (just an average grade) and sandstone of good character, while on all the rest of the road granite of good grade was used. This surface was laid in three layers of 2 inches, 2 inches and 1 inch. Two years after opening, a seal coat was put on and nothing has been done with it in the past six years. The same materials were used on the seal coat and I can distinguish no difference at all in these four sections of pavement. This road has carried up to 400,000 cars and trucks per season of eight months and the pavement is in perfect condition; but, it is laid on a perfect subgrade and 18 inches of telford.

Between the entrance of a ferry slip and the foot of a mile-and-a-half long hill, brick paved, on concrete base, with grades from 5 per cent. to 8 per cent., there is a rock fill 300 feet long. As this fill was expected to settle, it was decided to lay a temporary cinder surface on it. Three inches of clean steam cinders were spread and rolled with a 10,000-pound roller and one gallon per yard of bituminous binder was applied and lightly covered with more cinders. Two years later, another application of ½ gallon per yard of binder was made and lightly covered with cinders; at the end of another two years, this 300 feet of temporary surface is in perfect condition and more than 330,000 cars and trucks used it during the last eight months, and yet the crushing strength of cinders is not great.

In Eastern Ohio and Western Pennsylvania, much slag has been used and when treated about like limestone has made good surfaces. Many surfaces have been laid with crushed gravel, which is, of course, just like good crushed stone, if properly screened and washed before crushing. The usual specifications for this aggregate is 60 per cent. or more of material to have angular fragments.

But some surfaces have been laid with gravel without crushing and when this aggregate was clean, properly sized and bonded, these surfaces have been good. In Massachusetts and other New England States, this uncrushed gravel aggregate has been extensively used in the so-called "Tar Concrete Pavements" with success when the workmanship was good, and many old gravel roads have been successfully surfaced with only gravel aggregate.

Good workmanship means more in bituminous macadam surfaces than mineral aggregate does. It would seem much wiser for the engineer to carefully study all available local mineral aggregate and prepare his specifications to permit the greatest possible use of it in his surfaces, than to fall into the easier method of copying standard specifications and so compelling contractors to import these aggregates and so greatly increase costs.

Better put this extra money in your subgrade work, for that is really your road.

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CONTENTS

Well Co-ordinated Bridge Design

It is not necessarily or even probably the most valuable achievement or highest engineering to build a structure that is only the greatest, strongest, cheapest, or even the most beautiful or useful that can be made. The coordination of all these functions giving full and properly proportioned recognition to each with due consideration of surroundings, requirements, and harmonious whole; with provision for future development, maximum safety and the highest ratio of efficiency and durability to total cost, is the truest success.

Engineering development and improved standards are eliminating raw construction that in former years has been due to lack of development, facilities, funds and appreciation; omissions that have been especially apparent in great bridges where the precise computation of theoretically accurate strain sheets (based on assumed data), has been a temptation to build flimsy or offensive structures with little regard for beauty and durability. Structural steel is indispensible but its highest value and efficiency are secured when it is properly used, often supplementary to other materials, and the present tendency is to combine it with concrete for bridge superstructures except for the longest spans.

A case in point is the new Connecticut river bridge described on page 365, where a large sum has been wisely expended to provide a beautiful permanent structure of high economic value. The attention given to numerous considerations indirectly affecting its service and its relation to public requirements may almost be said to have produced a judiciously weighted design. It embraces well-developed improvements in advanced practice rather than radical or experimental features, thus insuring construction of a monumental character with full recognition of practical, financial, and artistic requirements.

Important features of its design are the balanced symmetry of outline relieved by graceful towers and the handsome cartouches on the main span that cost less than two per cent. of the total; the ashlar faced substructure; the proportioning of the river spans with graceful outlines and moderate dimensions providing for waterway and navigation at moderate cost; and ample approaches so satisfactory that they were largely donated by local interests.

Notable details of the design include self-supporting arch rib reinforcement eliminating falsework; graded rib concrete; rational type foundations; economic hollow piers; accurate and permanent arch adjustment; high class paving and roadway drainage; design facilitating erection; and independent arch stability for future radical reconstruction. Most of these features were particularized in the specifications and drawings and all of them, and more, are worthy of consideration for adoption or modification in many municipal bridge schemes.

New York Transit Construction

If the plans announced May 11 by the New York Transit Commission are carried out substantial relief will be afforded within five years to all of the passenger traffic of the city which has long been subject to constantly increasing inadequacy of facilities that are already disgraceful and intolerable.

Recent official investigations have shown that nearly all lines are seriously overcrowded and some of them, at the peak, are more than 100 per cent overloaded, causing great delay and dangerous conditions that seriously menace the health and comfort of millions of passengers and restrict the development and progress of the city.

Physical, financial and geographical conditions limit transit construction so much that it is doubtful if it will ever be settled in a completely satisfactory manner or entirely catch up with the demands that have hitherto increased faster than the facilities. For several years there has been an almost total cessation of improvements in traffic conditions, but vigorous action of the Rapid Transit Commission now promises prompt relief, which is badly needed.

The completion of detail designs should be hastened to the utmost and contracts awarded as rapidly as possible, giving the work under fair conditions to experienced and reputable contractors many of whom have successfully executed similar work and

are available to commence construction as soon as permitted and assured of fair and honest treatment.

The contracts should recognize the rights of the contractor and allow him fair profits and necessary freedom of action, and special care should be taken to provide against delay in furnishing him with necessary information, authorization and prompt payment for work satisfactorily executed. Reform is urgently needed for some clauses of former contracts whereby contractors were specifically held responsible for matters in which they were not free to exercise their best judgment, or conditions not under their control, and for the engineers' orders.

Some of the proposed work involves great engineering difficulties and will necessarily be costly. Probably there is nowhere else in the world that men and equipment so well qualified to execute the work successfully are available. They should be well compensated for its successful execution, which will not only vastly improve transit conditions but which will greatly stimulate construction work and general prosperity.

$318,000,000 Transit Contracts for New York

The New York Rapid Transit Commission announces plans for the extension of the present New York system by seven new lines which it is estimated can be put in service in five years.

These lines, in order of proposed construction are: Corona $2,800,000 extension; 42nd Street $6,000,000 crosstown; Staten Island $20,000,000 ferry and passenger tunnel; Broadway-7th Avenue $26,500,000 extension; Brooklyn $24,000,000 crosstown subway; Manhattan-Brooklyn $25,000,000 or $28,000,000 subway and tunnel; and the Manhattan-Washington Heights $69,500,000 subway.

The Flushing line will be a 3-track elevated structure from Corona to Flushing Circle drawbridge, thence a subway to Main Street and can be built in 3½ years.

The 42nd Street moving platform under the sidewalks would eliminate the present long walk and two waits and extended from river to river, will ultimately provide transfers for 27 up and downtown tracks. It can be built in 3 years.

The Staten Island connection may be a continuation of the 4th Avenue Brooklyn subway to Fort Hamilton, tunnel to Vermont Avenue, Staten Island, which can be built in 5½ years and supplemented by a ferry connecting Staten Island with the subway system in only 2½ years. Alternative to this plan is a tunnel from 67th Street, Brooklyn, to Arietta Street, Staten Island, also in 2½ years.

The extension of the Broadway-7th Avenue subway from 59th Street, Manhattan, to 155th Street and 8th Avenue, will afford the quickest possible relief by the completion in 3½ years of another full-length north and south line.

The Brooklyn crosstown line will follow Jackson Avenue, Long Island City, Manhattan Avenue, Greenpoint and Roebling Street to Bedford Avenue, Brooklyn, and with the Brighton Beach line at Fulton Street and Franklin Avenue and can be completed in 3½ years.

The Manhattan-Brooklyn line contemplates the removal of the elevated railroad in Fulton Street, Brooklyn, and construction of subway from Fulton and Clermont Streets to Sidney Place. From Sidney Place, two tunnel routes are available to the City Hall, New York. One runs from Grace Court, under East River to Nassau Street; the other from Livingston to Clinton Street, Liberty Street and Fulton Street, Brooklyn, under East River to Ann Street, Manhattan.

The Manhattan-Washington Heights line connects with the Queensborough subway at 41st Street, runs south 4-track through 8th Avenue to 14th Street and 2-track to Hudson and Chambers Streets. North, it is 4-track through 8th Avenue to 57th Street and Amsterdam Avenue to 155th Street, thence 3-track to 181st Street. It will be constructed in four sections, the first from 41st to 14th Streets, with 4 tracks with provision for 8 tracks, will cost $19,000,000; the second from 14th Street to a Chambers Street terminal, $7,500,000; the third, a double-deck, 4-track subway from 41st Street to 103rd Street, $24,000,000 and the fourth from 103rd Street to 181st Street, $26,000,000. All sections can be completed in 4 years.

The total construction cost is estimated about $174,000,000; administration, interest and engineering, $44,000,000, and equipment, $100,000,000.

Passaic Valley Sewer Tunnel

Work is about to be resumed on the outlet tunnel of the Passaic Valley sewerage system which has been under construction for several years.

The present contract, which was awarded to Holbrook, Cavot & Rollins for about $2,000,000, involves the construction of an outlet shaft and chamber house at Robbins Reef off the Staten Island shore, and a concrete lined tunnel 12 feet in inside diameter and about 15,000 feet long connecting the foot of this shaft with the abandoned tunnel started some years ago from the Jersey shore.

Part of the old tunnel invert has been concreted and this will have to be cleaned, re-excavated and the remainder of the lining completed and the new tunnel will be driven from two shafts.

The tunnel is partly in rock and partly in earth, but will probably all be driven under air pressure. The old plant is being repaired and supplemented and the work should be completed in 1924.

Water Consumption in Springfield

The daily average consumption of water in Springfield, Mass., in 1921, was 12,870,000 gallons, equivalent to 90 gallons per capita. About 900,000 gallons were used for municipal purposes, about 60 per cent of which was metered, this including most of the schools and other public buildings and the parks.

The highest rate of use of water for any hour during the year was occasioned by the use of city water for flushing snow through the sewers on February 23rd, when a rate for a short time of 27,500,000 gallons per day was recorded. Nearly 12,500,000 gallons were used for this purpose in four days during February, and destroyed all fire protection in many districts, and many of the suburban users complained that they were entirely without service. The largest used for fire fighting was 1,388,000 gallons on January 18th.

The largest amount of consumption in any one day was 16,340,000 gallons on June 22nd, and the smallest was 9,790,000 gallons on April 17th. As nearly as could be determined, regular sewer flushing took a little over 27,000,000 gallons of water during the year.

Columbus Filtration Items

Repairs Made in Solution and Dissolving Tanks, Stirring Machinery and Filters

The water softening and purification works of Columbus, O., last year treated 7,936 million gallons, about nine per cent less than in 1920. The bacteria were reduced from an average of 2,450 per c.c. in the raw river water to 24 in the filtered water; and the hardness from 269 p.p.m. to 100 p.p.m.—the lowest for six years past.

Considerable repair work has been required about the plant. Some of the more important items were as follows:

Repairing of Alum Solution Tanks and Alum and Soda Ash Dissolving Tanks—The alum solution tanks and the alum and soda ash dissolving tanks were beginning to disintegrate on the inside. These tanks (seven in all) were bush hammered and resurfaced with a rich mixture of cement and high silica sand.

Lead-lining Soda Ash Solution Tanks—The soda ash solution tanks have leaked more or less ever since the plant was put into operation thirteen years ago. A great deal of time and money has been spent in trying to stop this leakage, but without success. Shortly after these tanks were put into service an attempt was made to make them watertight by resurfacing the inside with a rich mixture of cement and high silica sand. This didn't do much good, so the tanks were resurfaced on the inside with a black asphaltic compound called "Bitumenastic." The soda ash was sometimes run into the tanks too hot and melted the Bitumenastic, so that the treatment was not successful. Later several attempts were made to stop the leaking by resurfacing the inside of the tanks with California Asphalt, but this treatment afforded only temporary relief.

These tanks are located on the third floor of the headhouse, and the soda ash was commencing to disintegrate the floor of the headhouse, thus endangering the whole structure, and it became absolutely necessary that these tanks be made tight. This summer they were lined with sheet lead, weighing eight pounds to the square foot, and are now holding satisfactorily.

Repairing stirring machinery in the Lime Saturators—The saturators have been given a complete overhauling during the past year. All bent paddles have been taken off and straightened, all broken shafts have been replaced, and on some of the saturators new belts have been provided, so that this part of the plant is in perfect condition.

Repairing the Stirring Machinery in the Lime Solution Tanks—The stirring machinery in the lime solution tanks has been a cource of petty annoyance for years because the paddles were too light. The accumulation of sludge to any depth at all would bend and twist the paddles and break the shaft gears. All of these paddles have been taken out during the past year and replaced with heavier ones.

Repair Work and Improvements Made to Filters and Filter Gallery—As the softened water passes through the filters, normal carbonates are deposited on the surface of the sand and also around the sand grains, causing them to grow in size. If this is allowed to go on indefinitely a mat forms on the surface of the sand and this mat in time becomes so heavy that the filters will not wash well, so that it is necessary to scrape this material off the filters occasionally, and also to throw out some of the sand. It is necessary to throw out some of the sand occasionally because the grains grow so in size, due to incrustation, that the sand level reaches up to the bottom of the wash troughs. This scraping and removing of sand has been done twice to all of the filters during the past year.

Tank Treatment of Sewage

Separate Sludge Digestion Tanks in Baltimore. Suggestions for Imhoff Tanks. Imhoff Tank Difficulties Due Largely to Faulty Design and Operation

In connection with the discussions of the advantages and difficulties experienced with Imhoff tanks that have appeared in Public Works during the past two months, it may be of interest to publish part of a paper by George T. Hammond read last winter at a symposium on sewage disposal held by the American Society of Civil Engineers. The portions having special bearing upon this question are as follows:

There has been an evolution from the ancient and odorous cesspool to the sedimentation and separate sludge-digestion tanks of this day. Experience and experiments go far to prove that the latter afford the most satisfactory method of tank treatment, securing a very high removal of suspended solids and complete digestion of the sludge, without much danger of a nuisance. Much experience with the design and operation, as well as with overloading and abuse, of such tanks, was gathered during the recent war, and the interested student can inform himself of many data from several important papers since published, of which I will only mention that presented by Major L. S. Doten to this society, which will be found with interesting discussions in Volume 83, page 337, of the "Proceedings."

One of the latest extensive projects in sewage treatment is the proposed enlargement of the Baltimore plant, concerning which the following statement has recently been made: "Everything points to the adoption of sedimentation tanks in conjunction with sludge digestion tanks as the most logical

solution of the problem for Baltimore conditions. None of the many troubles that have to be confronted in the operation of Imhoff tanks are found in treating sewage with sedimentation and sludge digestion tanks. No foaming is met with; no time is spent squeegeeing; no scum has to be removed; no skimming of tanks is required; and no uncertainties of operation have to be considered."

Our experimental work in Brooklyn on sewage treatment, extending over more than five years, appears to justify the conclusion reached in Baltimore as to the success of sedimentation and separate digestion, but we did not find much difficulty with the Imhoff tank. Our Imhoff tanks were possibly on a better line of behavior than those in Baltimore.

The Imhoff tank affords a method of obtaining separate sludge digestion in a chamber placed under the sedimentation chamber. It eliminates the necessity of actually transferring the settled matter from one tank to another, and thus has an advantage over the separate tank system. But that it has some unpleasant tendencies must be admitted.

Among the points of interest observed during our experiments, I have only the available time to mention the following:

1. For Imhoff tanks the sludge digestion capacity should be sufficient to carry the sludge without discharging for 8 months, and the capacity below the slots should be at least about 2 cu. ft. per capita for the population served. This large storage capacity is not only necessary for storage during non-drying periods but also it appears to have some important relation to the digestive process, and helps to prevent foaming.

2. Double slots—i. e., one slot at the bottom of each inclined plane of the sedimentation chamber, with a triangular baffle beneath, instead of one plane passing under the other, appears to give the best result in these tanks and largely eliminates the need of squeegeeing the slopes.

3. The slopes should be at least 1¼ vertical to 1 horizontal, and the flow should be parallel with the slopes and slots. A rate of flow equal to 1 ft. per minute is excellent.

4. Scumboards and baffles add to tank efficiency.

5. From observation I have reached the conclusion that two sludge digestion pockets under the sedimentation chambers are better than three, and that the best length for the sedimentation chamber would afford 60 ft. net, for the flow between scumboards at inlet and outlet. Provision should be made to reverse the flow.

During the war, and while in the employ of the U. S. Government, among my various assignments, I was detailed to take care of the design of an Imhoff tank plant for Harriman Village and other industrial housing projects and the city of Bristol, Pa., jointly. W. H. Boardman of Philadelphia was retained by the city, and we collaborated on this work, which consisted of three Imhoff tank units, each of a capacity to care for 2½ mgd. of sewage flow at 1 hour retention, or 1¼ mgd. at 2 hours.

The principles above mentioned were carried out in the design. The plant has been in operation about three years and has given excellent service. I understand that there has been no trouble with this plant, no odors, and that squeegeeing of slopes is very seldom required.

Many engineers have come to the conclusion that the Imhoff tank is an element of risk in a treatment plant. After having visited most of the larger and many of the smaller installations of this tank in this country and abroad, my opinion is that its bad name is due to a considerable extent to faulty design, and still more to faulty operation.

A word about retention period in tanks: Experience and experimental work indicate that this period should be short, usually not over two hours, even as brief as one hour will give the best results in many cases. Sedimentation is very rapid during the first hour, septic action may intervene during the second hour, and it is always desirable to keep the liquid portion of the sewage as fresh as possible.

Experimental results as well as observation tend to show that a period of two hours, while not affording the high percentage of removal obtained by longer periods, gives all the preparation required for sprinkling filters, or for direct discharge into a water-way affording sufficient dilution.

Chippewa-Queenstown Power Canal

This canal, about 30 miles long, has just been completed by the Ontario Hyrdoelectric Power Commission at a total cost of more than three times the pre-war estimate for the ultimate development of 500,000 horse power, derived by bringing water from about 30 miles above the upper Niagara Falls rapids to a point just below the lower rapids and thus utilizing a working head of more than 300 feet.

The river intake consists of a concrete deflection wall and six large concrete pipes submerged 35 feet below water level and delivering into the canal, which consists of 3½ miles of the rectified channel of the Welland river and 9½ miles of a wide and deep canal excavated through earth and rock, the upper end of which for about one mile was excavated by a suction dredge to an average depth of 25 feet.

Part of the excavation was through earth and below it to a considerable depth in rock. At one point there was an earth excavation and a rock excavation 85 feet deep with a berm carrying construction tracks at the feet of the 1:1 earth slopes that were rip-rapped and finished with gunite.

Up to water level the channel has a lining concreted with the aid of a wooden traveler having vertical, longitudinal steel plate faces with screw adjustments that are set to form the inner face of a wall about 1 foot thick.

In one place where the canal is carried on an embankment the canal has a V-shaped cross section with rip rap slopes covered with concrete reinforced with steel wire netting. Concrete strips 2 feet wide were first laid from top to bottom of the slopes at 18-foot intervals and on them steel plates were set at the bottom of the slope, loaded down with sand bags and served as forms for concreting the intermediate panel. After the concrete had set the forms were pulled up the slope, the next horizontal strip concreted and so on to the top. Concrete was delivered in dump cars and spouted to position. The construction equipment included 50 locomotives, more than 400 cars and 30 miles of track.

Engineers' Plans for State Health Boards*

Regulations of the State Boards of Georgia, Illinois, Indiana, Iowa, and Kansas, with respect to the matter and form of plans and reports required to accompany applications for water and sewerage permits.

Georgia. The Board requires plans and specifications to be filed two weeks prior to the date upon which action is desired.

Water Supply. The plans are to include a map of the district showing the proposed system, detail drawings of any special structure, and general and detail plans for water purification works. There shall also be a comprehensive report by the engineer, who may submit a preliminary report for the Board's consideration.

The general plan shall be to a scale not greater than 100 nor less than 500 feet to one inch. If any dimension is more than two miles, the map may be in two or more sections bound together and a small index map supplied. The map shall show all streets, surface elevations at street intersections and elevations of water at intake, in reservoir, etc.; sizes of pipes; "location of intakes, valves, hydrants, reservoirs, pumps, standpipes and purification plant, and any special structures.

The dimensions suggested, except for the map, are the same as in Arkansas. In general, the last paragraph of the Arkansas synopsis (page 323, issue of May 6) apply to Georgia. In connection with the water shed, map required showing roads and buildings, and discussion of storage capacity, average depth and area of reservoir, liability of odors or tastes, removal of color, etc.

Sewerage. Required-map of district, profile of all sewers, details of appurtenances, plans of disposal works, and engineer's report.

Map—as for water supply, except no scale less than 300 feet to one inch, contour lines shall be shown at intervals of not more than 10 feet, all existing sewers, existing and proposed outlets and overflows. Street and sewer elevations as for Arkansas.

Profile and detail plan requirements as for Arkansas.

Minimum grades as for Arkansas. Capacity should be sufficient to carry, when flowing half full, twice the average flow of 25 years hence, plus ground water.

Dimensions of drawings, as for water works.

The report and specifications are to include items as for Arkansas, except the list of bench marks.

"Under ordinary circumstances the Board will approve such plans only when designed upon the separate plan, in which all rain water from roofs, streets, and other areas and all ground water, other than avoidable leakage, is to be excluded." (This should have been given for Arkansas also.)

*Continued from page 342.

Illinois. "No rules or suggestions relative to sizes, scales, etc., of maps and plans have been prepared."

Indiana. "The department is co-operative and wherever it is possible we ask that the Water and Sewerage Department of the State Board of Health be called in on plans merely to co-operate with the municipality to gain an effiicent waterworks or sewage plant or sewers."

Iowa. Plans to be submitted at least two weeks before action is desired.

Water Works. General map of district and topographical map of catchment area and of reservoir site. Detail drawings of special structures. General and detail plans of purification works.

The instructions are closely similar to those for Arkansas, with the following exceptions: Specifications are requested typewritten on letter size paper. Plans for purification works shall show contours upon areas reserved for future extensions. Sizes of drawings, 24, 32, 40 or 48 inches long connections with pipes carrying less pure water must have valves that can be sealed by health board.

Sewerage System. A preliminary plan giving information sufficient for complete understanding of project must be submitted prior to submission of detailed plans.

The instructions are closely similar to those for Arkansas, with the following exceptions: Profiles, horizontal scale, 100 ft. to 1 in. Plans for a disinfecting plant are not part of the general requirements. Lengths of drawings as for water supply above. The last paragraph of the Georgia synopsis is used with the additional provision that "extensions to existing combined sewer systems may be approved"; but if combined sewage is treated, storm overflow must be controlled and reserve filters provided.

Kansas. Information required—general plans, detail plans, engineer's report and specifications.

Water Works. The map to show streets, street elevations, location of pipes, valves, etc., elevations of street intersections. If wells are used, location of houses, cesspools, swamps, sewers, etc., near enough to contaminate them. Scale from 100 to 300 ft. to 1 in.

Detail plans of purification plants to show arrangement, size and construction of sedimentation basins, mixing chambers and other features. Complete plans of lay-out, showing all devices, and filter company's plans.

The engineer's report should discuss for surface supply, the nature and extent of water shed, especially its sanitary condition and method of regulating or preventing pollution, with small map showing buildings, roads on watershed or within five miles of intake; capacity and details of reservoir. For ground supply, give depth, size, construction, etc., of wells or galleries, probable capacities, ground strata, description of tests. Population to be served, quantity of water to be supplied, depth of pipe.

Specifications for the whole construction must be submitted and estimates of cost are desired but not required.

(To be continued)

NEWS OF THE SOCIETIES

CALENDAR

May 22-25 — STATE PARK SECOND NATIONAL CONFERENCE. Bear Mountain Inn, Palisades Interstate Park, N. Y. Secretary, Edgar E. Harlan, Des Moines, Iowa.

June 4-6—AMERICAN ASSOCIATION OF ENGINEERS. 8th annual convention. Salt Lake City, Utah.

June 5-7—NATIONAL CONFERENCE ON CITY PLANNING. Annual conference. Springfield, Mass. Secretary, F. Shurtleff, 60 State St., Boston, Mass.

June 6-8 — CONFERENCE OF NEW YORK STATE MAYORS AND OTHER CITY OFFICIALS. Annual meeting. Poughkeepsie, N. Y. Secretary, W. P. Capes, 25 Washington Ave., Albany, N. Y.

June 7 — NORTHWEST SECTION, NATIONAL ELECTRIC LIGHT AND POWER ASSOCIATION. Boise, Idaho.

June 12-15 — CANADIAN GOOD ROADS ASSOCIATION. Ninth annual meeting. Empress Hotel, Victoria, B. C. (Change of date.)

June 13—ENGINEERING SOCIETY OF AKRON. Akron, Ohio.

June 16-17—ENGINEERING INSTITUTE OF CANADA. Provincial meeting. Vancouver Hotel, Vancouver, B. C.

June 19-22—AMERICAN INSTITUTE OF CHEMICAL ENGINEERS. Summer meeting. Clifton Hotel, Niagara Falls.

June 20-23—SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION. Annual convention. University of Illinois.

June 21-22—AMERICAN SOCIETY OF CIVIL ENGINEERS. Annual convention. Portsmouth, N. H.

June 26-30—AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Annual convention. Niagara Falls, Ont.

June 26-July 1 — AMERICAN SOCIETY FOR TESTING MATERIALS. 25th annual meeting. Chalfonte-Haddon Hall Hotel, Atlantic City, N. J.

Aug. 15-18 — INTERNATIONAL ASSOCIATION OF FIRE ENGINEERS. Fiftieth convention. Municipal Auditorium, San Francisco, Cal. Secretary, James J. Mulcahey, Chief, Yonkers, N. Y., Fire Dept.

Aug. 28-Sept. 2—NATIONAL SAFETY CONGRESS. Detroit, Mich.

Sept. 11-15—ASSOCIATION OF IRON AND STEEL ELECTRICAL ENGINEERS. New Auditorium, Cleveland, Ohio.

Sept. 12-15—NEW ENGLAND WATER WORKS ASSOCIATION. 41st annual convention. New Bedford, Mass. Secretary, Frank J. Gifford, Tremont Temple, Boston, Mass.

Sept. 25-28 — SOUTHWEST WATER WORKS ASSOCIATION. Annual convention. Hot Springs, Ark.

Oct. 9-13—AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS. Annual convention. Cleveland, Ohio.

Oct. 16-19 — AMERICAN PUBLIC HEALTH ASSOCIATION. Annual meeting. Cleveland, Ohio.

Nov. 15-16—NATIONAL INDUSTRIAL LEAGUE. Annual meeting. New York City. Secretary, J. H. Beck, Chicago.

Dec. 7-13—NATIONAL EXPOSITION OF POWER AND MECHANICAL ENGINEERING. New York City.

BOSTON SOCIETY OF CIVIL ENGINEERS

The Boston Society of Civil Engineers has elected the following officers: President, Dugald C. Jackson; vice-president, Charles M. Allen; secretary, John B. Babcock, 3d, and treasurer, Frank O. Whitney.

RICHMOND CHAPTER, AMERICAN ASSOCIATION OF ENGINEERS

This chapter elected the following officers: President, J. C. Carpenter; vice-president, E. T. D. Myers, Jr.; secretary, Albert C Dunn, and treasurer, E E. Davis.

BROOKLYN ENGINEERS' CLUB

On April 29 about sixty members of the club were the guests of the United Electric Light & Power Company, New York, and after being entertained at a luncheon, the party was taken by automobile to the new Hell Gate Station at 134th street and East River, where the engineers inspected the 150,000 K.W. installation having many novel and interesting features in power plant line. This station is one of the largest and most complete, just built, and is intended to have an ultimate capacity of 300,000 K.W. Its construction has involved many interesting features, some of which regarding the intake and discharge tunnel have been described in Public Works.

TRI-STATE WATER AND LIGHT ASSOCIATION

The twelfth annual convention of the Tri-State Water and Light Association, of the Carolinas and Georgia, was held at Spartanburg, S. C., April 18-20. At this meeting it was decided to enlarge the geographical field of the association to include Florida, Alabama and Tennessee.

The new president of the association is J. E. Gibson, superintendent and engineer of waterworks, Charleston, S. C.; and W. F. Stieglitz, Columbia, S. C., was re-elected secretary and treasurer.

Among those discussing the various topics presented were E. L. Filby, sanitary engineer, S. C., state board of health; H. F. Lee, manager, Carolina Power and Light, Goldsboro, N. C., and W. M. Rich, city manager of Goldsboro. Waterworks appliances were exhibited.

NEW YORK SECTION, AMERICAN SOCIETY OF CIVIL ENGINEERS

At its regular monthly meeting of May 17th the New York section, A. S. C. E., discussed the need for regional planning for the New York District. The discussion was opened by Charles D. Norton, first chairman of Chicago plan.

ROCHESTER ENGINEERING SOCIETY

At the meeting of May 5th the paper of the evening was on the history and manufacture of vitrified clay pipe by J. W. Lea. On May 12th the society was addressed by F. E. Colley, president of the Federated American Engineering Society.

On May 19th the society will be addressed by Dexter M. Kimball, president of the American Society of Mechanical Engineers and Dean of Sibley College, Cornell University.

AMERICAN ASSOCIATION OF ENGINEERS

The Rochester Chapter was addressed May 1st by John Dunbar, Superintendent of Parks, City of Rochester, on the work of the Park Commission.

PERSONALS

La Noue, W E., has resigned as city engineer of Victoria, Texas, and E. R. Thomas, of Port Arthur, has been appointed as his successor.

Lea, S. H., county engineer of Mineral County, W. Va., has resigned to accept an appointment as district engineer in charge of road construction for Cacapon district, Morgan County, W. Va.

Norckauer, W. H., has been appointed office engineer of the State Highway Commission, succeeding W. F. Cooper.

Davis, W. H., has been appointed maintenance engineer, West Virginia State Road Commission, with headquarters at Clarksburg.

Stoelting, R. E., formerly city planning engineer, Milwaukee, Wis., has been appointed commissioner of public works.

Graham, Alexander W., chief engineer of the Missouri State Highway Commission, has resigned, and his assistant, C. W. Brown, is acting chief until election.

Murray, C. W., for many years city engineer of Tampa, Fla., has been made director of public works and public welfare with an increase in salary. He will have charge of preparing plans for the city's $400,000 harbor development.

Leyden, Harry S., chief inspector of highway construction of Fresno County, Cal., has been appointed county superintendent of highway construction and maintenance, the appointment to be effective July 1st.

Hedrick, J. J., Jr., county engineer of Hillsborough County, Fla., has resigned, and Allan Pimm, his assistant, has been appointed county engineer.

Emerson, Fred, assistant city engineer of Lockport, N. Y., has been appointed city engineer of Batavia, N. Y.

Doan, L. A., until recently assistant engineer of bridge construction, Indiana State Highway Commission, has been appointed assistant district engineer in charge of bridges for the upper peninsula of Michigan.

Smith, E. S., of Youngstown, Ohio, has resigned as chief of the division of public works in the State Highway Department of Ohio on account of ill health.

Finck, George E., has been made highway engineer of Greensboro, N. C.

Wasser, Thomas J., state highway engineer of New Jersey, has been elected president of the newly created state board for licensing professional engineers and surveyors.

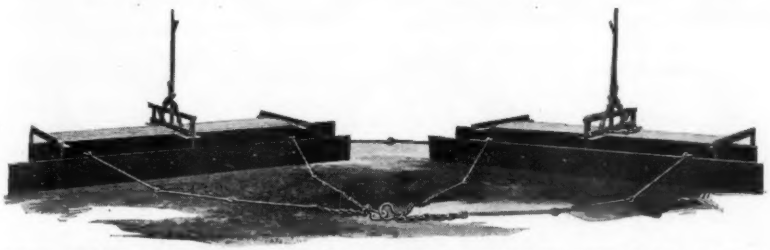
Reed, George A., Montpelier, Vt., formerly assistant state engineer of Vermont, has been appointed state engineer, succeeding D. O. Young, who resigned.

Torkelson, M. W., bridge engineer of the Wisconsin Highway Commission, has been appointed engineer secretary, and W. C. Buetow, assistant engineer, has become bridge engineer, succeeding Mr. Torkelson.

Whitfield, J. D., has been elected city manager of Terrell, Texas.

New Appliances

Describing New Machinery, Apparatus, Materials and Methods and Recent Interesting Installations



GOOD ROADS MACHINERY COMPANY'S WINNER SPECIAL 2-WAY ROAD DRAG.

THE WINNER SPECIAL 2-WAY ROAD DRAG

The Winner Special 2-Way Road Drag, manufactured by the Good Roads Machinery Co., Inc., is simply two road drags, exactly alike in construction, joined together by a connecting link. It is designed and furnished to fill a very large demand for a drag of exceptionally large capacity to be used with traction power, and can be handled to advantage with six mules or with a 10-H. P. tractor.

The Winner Two-Blade Drag, with independently adjustable blades, suits average conditions of dragging. It is light in weight, but being built of steel, is exceptionally strong and durable.

The connection from one blade to the other is made adjustable so that the blades can be set at any angle desired independently of each other. By means of this special device the blades can be set for doing work that cannot be accomplished by the rigid blade types of road drags.

The operating lever is arranged with a long sweep in order to allow the blades to be set at sharp angles.

The link can be set at any point desired in the chain, thus regulating the angle of the drag when in operation.

The Winner Special 2-Way Road Drag in ordinary dragging work will cover about 15 feet of roadway. It is hardly necessary to say, therefore, that one of these drags will maintain a very large mileage of roads.

The drag complete weighs 635 pounds. It is equipped with four hooks at the rear, so that an extra drag, heavy chains or a leveling log or board can be attached for smoothing the roadway behind the drag.

This drag will appeal to users because of its ease of operation, durability and capacity for covering a large amount of roadway in a limited time.

Large numbers of these drags are being used with excellent results by the State Highway Department of North Carolina.

20-TON "B" ERIE STEAM SHOVEL

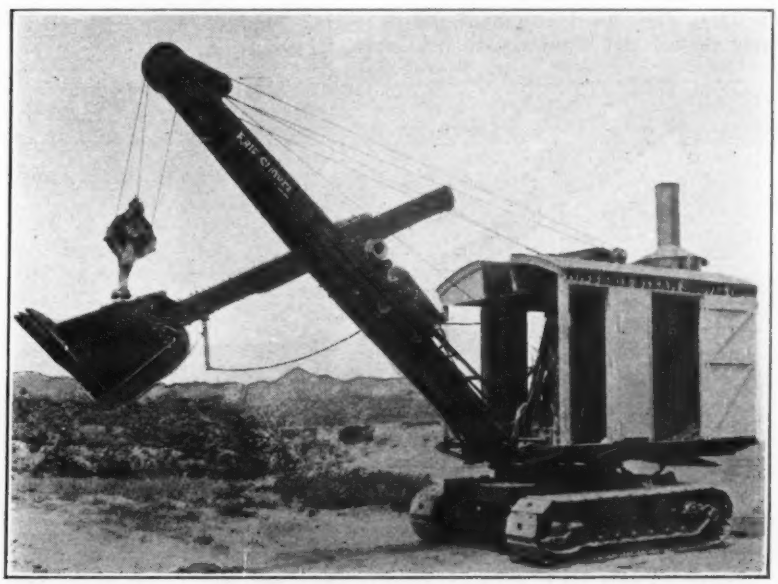
A re-design of the 1921 Erie Steam Shovel has been completed and shipments are now being made of the new machine, which retains all of the good features of the former one, of which more than 1,700 are now in service and have provided much important data for the determination of the correct sizes for shafts, bearings and other important parts of the improved model.

The new machine has more power than has been previously provided for steam shovels of the 20-ton class and is able to handle a full size ¾-yard dipper with a 21-foot boom and 18-foot 6-inch dipper handle. There are many improvements in the details of the trucks and turntable and the traction wheel mounting is interchangeable either with car wheels or with the lubricated caterpillar type introduced last season which has internal lubricating reservoirs.

There is an entirely new automatic tripping device that makes the operator's work much easier and lengthens the working season. The dipper has a double-hinged latch lever which cannot become bent and does not break wagon or car boxes. Many improvements have been made in the boom, the gears and the shipper-shaft besides a number at the power-producing end of the new machine, which has a larger boiler and a new auxiliary exhaust.

The new 1922-1923 Erie has a wider all-round usefulness than has previously been developed in one steam shovel and can be quickly converted to a locomotive crane to handle a clamshell bucket, orange-peel or dragline bucket; it is easily changed over to a steam hoe for trench excavation; or it can be readily equipped with trucks for railroad ditching. For regular steam shovel service it is suitable for road grading, cellar excavation, quarrying rock, excavating sand and gravel and other ordinary work. The steam hoe, traveling on solid ground in advance of trench excavation, prevents cave-ins and handles hard materials and large boulders with all the strength and power of a steam shovel.

The Erie Steam Shovel Company, by which the machine is manufactured, calls attention to the higher standard of workmanship and better materials in this machine than have been possible at any time before since 1916.



ERIE STEAM SHOVEL WITH INTERNAL LUBRICATED CATERPILLAR TRACTION AND AUTOMATIC BUCKET TRIPPING DEVCE.

A DOLLAR A DAY FOR FUEL

A few months ago the Bucyrus Co. announced the addition to its line of products of a gasoline shovel of a distinctly novel and very much improved type, the most revolutionizing feature of which was the ingenious method of operating the thrust without the use of an independent engine mounted on the boom whereby even more power is obtainable than with a steam shovel of the same size.

This company has now developed, after a long period of thorough experimentation, the use of a Diesel type engine for this shovel, the importance of which announcement lies principally in the greatly reduced fuel cost.

This shovel, known as the Bucyrus 30-B oil shovel, will use as fuel any cheap, low grade oil of high heat value which will flow freely.

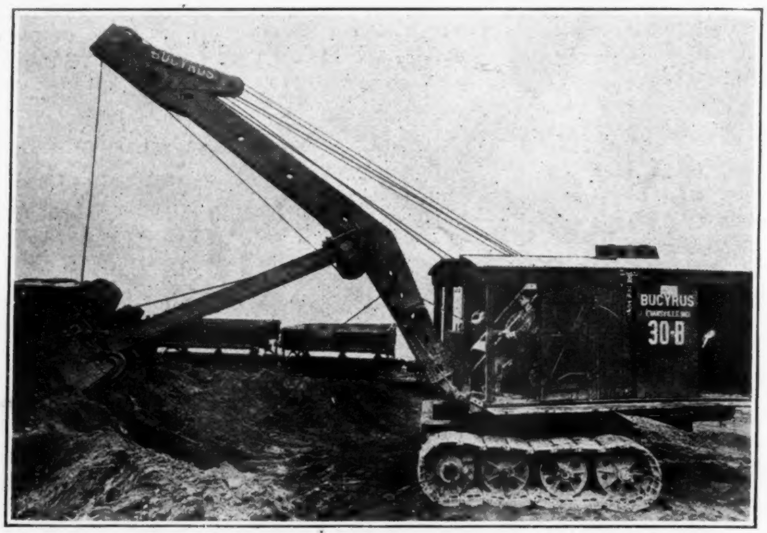
This machine has been severely tested, both as a shovel and as a dragline, for several months, under strenuous winter conditions. With fuel oil at 6c per gallon it consumed 1¾ to 2¼ gallons of fuel oil per hour, or, roughly, between $1 and $1.25 per day of average operation.

The fuel cost of any shovel differs widely in different sections of the country. Conservatively stated, however, such a steam shovel will burn about 1½ tons of coal in 10 hours. With coal at $6 per ton delivered, this means a daily fuel cost of not less than $9. A saving of $8 per day on fuel alone is thus possible. To this figure may be added several other items thus eliminated, notably, the saving made possible in not having to pay the cost of a team to haul water and coal.

The engine is of the full Diesel type, not the semi-Diesel. It is a mechanical injection engine, developing 55-h. p. at the conservative speed of 360 R.P.M. Its cylinders are 8x10½ inches. It is a heavy duty, slow speed engine of particularly rugged and heavy construction.

This Diesel type engine differs from the gasoline engine principally in that it is a constant pressure engine, the fuel being burned directly in the cylinders without the aid of a carburetor, spark plug or outside heating appliances. In the gasoline engine the mixture is taken into the cylinders, compressed, and then ignited by some auxiliary mechanism. The pressure then rises in the nature of an explosion. In the Diesel type engine the fuel is injected into the cylinders at a constant pressure in an atomized state. It is fired by the heat developed by the compression of air in the cylinders on the previous stroke.

The 30-B oil machine, equipped with a Diesel engine, may be furnished either as a shovel, a dragline, a clamshell or a locomotive crane.



BUCYRUS OIL SHOVEL WITH 55-H. P. DIESEL TYPE ENGINE.

"PO" OIL ENGINE

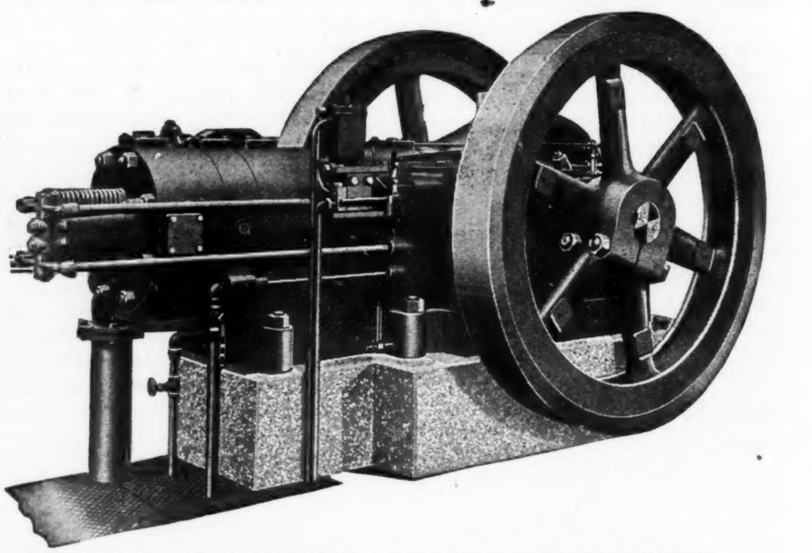
The Price Type "PO" Oil Engine, manufactured by the Ingersoll-Rand Company, offers late development in horizontal oil engine design and construction operating on the four stroke cycle.

The satisfactory results obtained with this engine are due to the harmonious design of all its related parts. All of the mechanism is simple and reliable and the engine as a whole is not sensitive nor difficult to maintain.

The most outstanding feature of the design is the shape of the combustion chamber and the arrangement and construction of the spray nozzle used for direct-injection of the fuel. Fuel injection and complete atomization are obtained without the use of high pressure air, and ignition by heat of compression only.

Other noteworthy features are the enclosed and oil-tight crank case; the pressure lubrication system for oiling all important bearings, including cam rollers; the continuous filtration of lubricating oil; and the completely water-jacketed cylinder and heads.

The Price Type "PO" Engine is most economical in the consumption



INGERSOLL-RAND COMPANY'S PRICE TYPE "PO" OIL ENGINE.

of fuel. Sixteen to seventeen brake horsepower hours are obtained from a gallon of fuel oil. Less floor space is required than with a horizontal engine employing a piston rod, crosshead, crosshead guide and connecting rod. The unbalanced reciprocating forces caused by reciprocating weights are much less with the trunk type engine than in the horizontal engine employing a crosshead. The engine exhaust is invisible. The labor charge is low. Highly skilled operators are unnecessary.

The 100-horsepower engine will run five days of eight hours each, with the expenditure of only one gallon of lubricating oil.

The Price Type "PO" Engine is especially suited for driving direct-current generators, oil or water pumps, air, gas or ammonia compressors, or for belting to line shafts.